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# OPALS

BY

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# OPALS[1]

By I. Aitkens[2]

## INTRODUCTION

The opal, long in disfavor because it was considered "unlucky," has become much more popular in recent years. For variety and beauty of color the precious opal is without a peer. These colors do not come from any chemical constituent but are produced by structural peculiarities, which in varying degrees deflect the light rays entering the stone and give a prismatic play of hues.

## DESCRIPTION AND PROPERTIES

Unlike most gem stones, the opal is not crystalline. It is a solidified jelly consisting mainly of silica ($SiO_2$), together with a certain amount of water. In precious opal the water content ranges from 6 to 10 per cent. Like other amorphous minerals, opals have the faculty of absorbing foreign matter, and frequently impurities such as calcium, iron, magnesium, sodium, and aluminum compounds, as well as bitumens, are present.

Opal is somewhat soft, the hardness ranging from $5\frac{1}{2}$ to $6\frac{1}{2}$ on Moh's scale; hence, it is easily scratched. It is isotropic, and the index of refraction ranges from 1.44 to 1.45, depending upon the water content. It is light in weight, the specific gravity being 2.1 to 2.3.

The beauty of the opal is the characteristic play of color or opalescence. The luster is vitreous, dull, or greasy. Although colorless when pure opals may be tinted pink, blue, and even black by impurities. The colors vary greatly; and the most beautiful play of tints is to be observed, especially in the precious varieties. The mineral itself may be transparent or opaque.

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[1] - The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6493."

[2] - Rare Metals and Nonmetals Division, U. S. Bureau of Mines.

There are many varieties of both precious and common opal. Precious opals are those that have a good play of colors; they include the following varieties:

| | |
|---|---|
| White opal | light colored. |
| Black opal | dark gray, blue, and black. |
| Harlequin opal | uniform patches of color. |
| Lechosos opal | green play of colors. |
| Fire opal | yellow, red; fiery play of colors. |
| Girasol | blue, white; red play of colors. |
| Opal matrix | opal in its matrix. |

The following are classed as common opal, as they exhibit very little play of colors:

Milk opal; resin opal; agate opal; opal jasper; prase opal; rose opal or quinzite; liver opal or menilite; wood opal; hyalite; hydrophane; tabasher; cacholong; moss opal; geyserite or silliceous sinter.

## USES

Certain opals are among the most beautiful and fascinating of gem stones and are correspondingly expensive; others are less costly. Precious opal and fire opal are especially valuable as gems. Common opal and opalized wood are sometimes used as gems and are also cut and polished for paper weights and similar ornaments.

The fact that opal is not very durable discourages its use where it is likely to encounter hard wear. It is not only comparatively soft, but also brittle and porous. It is well suited for pendants, brooches, necklaces, and like articles, but when mounted in rings the stone must be carefully protected by the setting. Opal for jewelry is always cut cabochon to bring out the brilliant coloring to best advantage.

## IDENTIFICATION

Opal is easily identified by its unusual colorings. No other precious stone approaches its internal color, so that this property together with the low specific gravity and index of refraction, serve to identify it immediately.

## SUBSTITUTES

The material of which opal is composed may be easily produced artificially. However, it is difficult to reproduce the brilliant internal color phenomena shown by the natural stone. Because of this and because of their relatively low value, artificial opals have little if any commercial importance.

## HISTORY[3]

The name opal comes to us through the Latin opallus, applied to the same species; but the word has a far older origin, which has not been traced. The Romans also used the word paederos, a Greek designation for Cupid, and hence applicable to all rosy stones. The name cacholong, for the bluish-white porcelain variety, which is very porous and adheres to the tongue, is of Tartar origin.

## OCCURRENCE

Opal occurs as a secondary deposit in fissures in many kinds of rocks, especially in recently erupted lavas, as well as in petrified wood and other fossil material. It is formed in a variety of ways, but chiefly as a result of the decomposition of silicate minerals by hot waters. The dissolved silica is subsequently deposited in gelatinous form from solutions of silica and hardens as water is gradually expelled.

According to Dana it fills cavities and fissures or seams in igneous rocks, also in some metallic veins; and is embedded, like flint, in limestone and sometimes, like other quartz concretions, in clay. It is also formed from the siliceous waters of hot springs, and results from the mere accumulation, or accumulation and partial solution and solidification, of the siliceous shells of infusoria, of sponge spicules, etc., which consist essentially of opal-silica.

## MINING

Opal mining is essentially a small-scale surface proposition; large-scale operations seldom prove remunerative. As a rule the finding of "color floaters" is the first step in prospecting. The proximity of a vein is usually indicated by the presence of more or less bleached opal in the soil, and these indications are followed until the vein itself is located. Sometimes, however, prospectors dig at random or sink a series of shafts and connecting tunnels. Once found, the vein is followed with great care, and the opal is taken from the matrix with a pocket knife. Such trimming as is necessary is accomplished with a pair of pliers, and then the material is ready for sale as rough stones.

### Polishing

The rough stones are handed over to the polishers, who first shape them on an ordinary, large grindstone. After being roughly shaped to the best possible size consistent with symmetry and beauty the stone is passed on to a sandpaper machine. A final polish is then given by vigorous rubbing on soft leather.

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[3] Smith, G. F. H., Gem Stones: London, 1912, p. 251.

## DOMESTIC PRODUCTION

Opal-bearing deposits have been discovered in Nevada and Washington in very recent years. However, production statistics for the United States are not available after 1921, when the United States Geological Survey discontinued the canvass of producers. Some very large stones have been produced and valuable deposits have been discovered during the interim, but no definite statement can be made as to the size of the present domestic output.

Table 1.- Value of opal produced in the United States, 1898-1921[1]

| Year | Value | Year | Value | Year | Value |
|---|---|---|---|---|---|
| 1898 | $200 | 1906 | ------- | 1914 | $1,114 |
| 1899 | None | 1907 | $ 180 | 1915 | 1,850 |
| 1900 | None | 1908 | 50 | 1916 | 1,838 |
| 1901 | None | 1909 | 200 | 1917 | 805 |
| 1902 | 150 | 1910 | 270 | 1918 | 6,304 |
| 1903 | 200 | 1911 | 1,875 | 1919 | 2/ |
| 1904 | None | 1912 | 10,925 | 1920 | 2/ |
| 1905 | None | 1913 | 15,130 | 1921 | 336 |

1 - Compiled from U. S. Geol. Survey Mineral Resources of the United States (annual chapters).

2 - Less than three producers; figures not published separately.

## DOMESTIC DEPOSITS

### Nevada

In variety the Nevada opals are unsurpassed. They range from clear, transparent forms with broad flashes of color to coal-black stones with vivid flashes of red, blue, and green. It was from the Rainbow Ridge Mining Co.'s property in Nevada that an opal weighing 16.95 troy ounces was obtained. This exceptional stone is displayed in the National Museum in Washington, forming part of the Roebling collection.

These mines are situated in what is known as Virgin Valley, Humboldt County, Nev., and are near the Oregon State line. Many beautiful opals have come from this district, but most of them tend to crack and consequently have proved a disappointment to the trade. Opals were first found in this region in 1908. It is largely a desert region, where the opals occur associated with petrified wood in beds of volcanic ash. Sometimes the cracks of a piece of petrified wood are completely filled up with flashes of blue and red. Occasionally one finds a whole opal twig.

According to Doctor Kunz,[4] one of the largest opal-bearing deposits in the world was discovered a few years ago in the Thousand Creek district, 50 miles north of Winnemuca, Nev. Although small numbers of stones have been mined here for a number of years, it was only recently that the true extent and value of the deposits became known. Here, too, the opals range through a wide variety of colors, but unfortunately they carry a considerable amount of moisture and when brought directly into the air, dry out too rapidly and fall to pieces. To prevent breakage these stones may be buried for several years, allowing them to lose their excess moisture slowly and to temper them. However, as the water is a definite constituent loss of it is likely to cause breaks and flaws.

## Washington

There is a valuable deposit of opal in the northeastern corner of Washington.[5] Here, a considerable variety of qualities and sizes is found. Some of the material is exceedingly brilliant and will command the price of high-class jewelry. The larger masses, however, are mostly opaque material, and although they have not much "fire" may be utilized for cheaper jewelry. Little work has been done on these deposits, but enough to show that exploitation will be profitable.

Opal is found in other localities in the State. In 1890, for example, the mineral was discovered during the digging of a well on the land of George O'Donnell, about 5 miles northwest of Moscow, Idaho. Some very fine opals were obtained from this locality; the yield in 1891 was estimated at over $5,000.

## North Carolina

Doctor Kunz[6] has noted a most interesting occurrence of hyalite, a clear variety of opal, at Crab Tree, Mitchell County, N. C., 2 miles from the Asheville road, in the Hollifield mine at the base of Mount Mitchell.

## Other States

Deposits of some value have been found also near Fort Bayard, N. Mex.; in the Owyhee Range, Owyhee County, Idaho; east of Johannesburg, Calif., and in San Bernardino County, Calif.; along the Deschutes River, Crook County, Oreg.; and near Alpine, Tex.

## INDUSTRY IN FOREIGN COUNTRIES

Since the early part of the nineteenth century Australia has been the greatest opal-producting country of the world. It has become famous for its fine-quality opals, and the claim is made that gems from this country surpass any produced elsewhere. Hungary and Mexico have been the other important sources, outside of the United States.

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[4] - Kunz, Geo. F., Precious and Semiprecious stones: Min. Ind., 1926, p. 589.
[5] - Kunz, Geo. F., Precious and Semiprecious stones: Min. Ind., 1923, p. 584.
[6] - Kunz, Geo. F., Precious and Semiprecious stones: Min. Ind., 1927, p. 511.

## Hungary

Hungarian stones are well-known to the trade, and for more than two centuries most of the fine opals came from this source. The oldest and most noted locality, from which possibly the Romans obtained their gems, lies in northern Hungary at Czerwenitza. In the Hofmuseum at Vienna are some of the best stones from this region, including one of the finest and largest opals of the world, a single mass as big as a man's fist and showing a most exquisite play of colors.

The discovery of opals in Australia reduced prices and finally about 1920 resulted in the practical closing down of these famous Hungarian mines. The Czerwenitza mines have been worked so long and so completely that they now yield only a few stones larger than a hazel nut.

## Australia

The opal industry in different parts of the Commonwealth of Australi has been on a paying basis for years. New finds and exceptional stones are being unearthed continually. The value of the Australian output of black opal alone from 1908 to 1928, has been estimated at $5,000,000.[7]

Opals were discovered in Queensland about 1880, in New South Wales about 1883, and in South Australia about 1915. Not until 1908 was the black opal known to the trade, when it was first found in the Lightning Ridge district of New South Wales. Later an entirely new field of white opals was discovered at Tintenbar, about 50 miles south of Sidney, in New South Wales; and then about 1925 or 1926, a new field was opened up at Grawin, New South Wales, which is an extension of the old Grawin field that was worked out about 1910.

Most of the world's supply of first-class opals now comes from the Darling River in New South Wales and southwestern Queensland. Opals have bee produced at Sandy Creek in Queensland, at White Cliffs and Lightning Ridge in New South Wales, and at Coober Pedy in the Stuart Range of South Australia. Several exceptional opals have been found in recent years at both Lightning Ridge and Grawin. However, those from Lightning Ridge are said to surpass anything produced elsewhere.

## Mexico

Mexico is noted for its fire opals, which have been found in the State of Queretaro, at Zimapan in Hidalgo, and elsewhere. Other kinds of opa also are found in these places. The Mexican fire opal enjoys only a limited popularity, as it is more transparent than the ordinary precious opal and the colors are less fiery and apt to fade. These stones are usually brownish-red, with various indistinct floating colored lights.

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[7] - The Jewelers' Circular, Australian Black Opal: Sept. 13, 1928, p. 82.

About 1927, opals, discovered in the western section of the State of Chihuahua, were examined in the geological department in Mexico City and classified as stones of good quality. The hope was expressed that this industry might be placed on a commercial footing and the stones marketed in Germany and the United States.

## MARKETS AND PRICES

The price of opal varies greatly, according to the color and the uniformity and brilliance of the opalescence. In the world markets common opal can be bought as low as a shilling a carat, whereas a good dark stone displaying a flaming opalescence commands a fancy price. Fire opal runs from 2 to 10s. a carat.

A Montana dealer offers opals (rough), from one-half inch pieces as low as 10 cents to larger cabinet specimens up to $20. Partly polished or "faced-up" opals $\frac{1}{2}$ to $1\frac{1}{2}$ inches in diameter are quoted at 60 cents to $1.00, while "gemmy" pieces range up to $15.

An Australian (Melbourne) dealer offers large specimens (rough) of Australian opal at 5 to 50 s. each; in quantities, from 5 s. to £ 5 per ounce and upward; and small specimens from 1 s. each and upward. Polished specimens are offered for 10 s. to £ 7 each; and cut and polished specimens (ready for mounting), from 2 s. 6 d. per carat and upward. Small sizes of black opal specimens are offered for 2s. 6d. to 15 s. each; large sizes from 20 s. to 50 s. each and upward; and in quantities from 1 s. to 20 s. per carat and upward.

Although stones of speimen quality may be bought very reasonably, good large stones displaying flaming opalescence are exceedingly rare and bring a high price. According to P. B. Prior,[8] the "Pandora opal," which was recently unearthed in Lightning Ridge, weighed 790 carats in the rough and about 590 when cut and polished. This stone would undoubtedly bring the highest price ever paid for a single stone on the ridge. He further states that the "Flame Queen," found in the same district some years ago, which sold for $460 was afterward sold to a Mr. Cupples of Brisbane for $2,500. In discussing the unusual stones produced in Australia and the prices they brought, Prior makes a further statement as follows:

> Undoubtedly the biggest gems for their superb quality of opal were those got by Irwin and Brown on the Telephone workings 12 years ago. The largest stone weighed when cut and polished 225 carats, and the smaller one over 80 carats. I have never seen any stones approaching them. Unfortunately for the owners, they unearthed these stones about five years too soon. Had they got them later, they would have received

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[8] - Prior, P. B., Work cited, p. 82.

at least four or five times the money for them. These two stones with three other large gems, were sold at the rate of about $6 per carat. The same quality opal today is sold for from $40 to $50 per carat. E. Sherman was the purchaser, and since then the buyer stated in an interview with the "Chicago Daily News" that a stone which he purchased in his trading days at Lightning Ridge was the previous year sold in London for $70,000. We must assume that this large stone was the one.

To give your readers some idea of the value of Austalia's greatest gems, I have known Dick Huggard to sell a stone weighing a carat for $150, the rate being $21,500 per ounce. On three occasions stones have been sold at $100 per carat. E. Wollaston, the opal buyer of South Australia, has a stone just about 50 carats.

Lightning Ridge is not the only field today producing beautiful opal, for on the New Grawin field, which is only in its infancy, some wonderful stones have been brought to light. Only quite recently Frank McKenna gave me the following list of four stones, which have come from his claim, namely, one weighing 100 carats, sold for $2,150; one 150 carats, sold for $1,650; one 80 carats, sold for $750; one 150 carats, sold for $1,150.

These are the exceptional stones, however, and are not found in lar numbers. Neither is there a ready market for such stones, since the price rests entirely with the buyer and seller.

Usually opals are bought from the fields by buyers and shipped to London and other markets. This method did not prove entirely satisfactory, as the miners were forced to accept whatever prices were offered. For instanc in New South Wales, where the opals are sold to buyers on the field, during 1918 there were only three buyers and consequently not much competition; the price remained low, from 1's. to £ 30 per ounce. The miners sought aid from the State, declaring a virtual monopoly existed since all the stones were bein purchased for one London firm. Finally, about 1924, the industry sent its own representative to the British exhibition and disposed of practically the whole output for the year to advantage. Since then the miners through their representative have been able to obtain better prices for their output.

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